

**Before the
Federal Communications Commission
Washington, D.C. 20554**

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| In the Matter of |) | |
| |) | |
| Digital Audio Broadcasting Systems |) | |
| And Their Impact On the Terrestrial Radio |) | MM Docket No. 99-325 |
| Broadcast Service |) | |

Comments of iBiquity Digital Corporation

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EXECUTIVE SUMMARY

iBiquity Digital Corporation, hereby provides its response to an April 19, 2002 Commission Public Notice seeking comments on iBiquity's AM IBOC technology and proposals for implementation of IBOC later this year. Specifically, the Public Notice sought comment on the National Radio Systems Committee ("NRSC") Report endorsing the iBiquity AM IBOC system and iBiquity's own Test Report. As is discussed in greater detail in these comments, iBiquity encourages the Commission to promptly endorse IBOC and the iBiquity system as the best means for introducing DAB in the United States and to facilitate the commercial introduction of IBOC technology later this year.

In its Report, the NRSC strongly recommends that the FCC move forward with the authorization of AM daytime IBOC. The NRSC based its endorsement on its conclusion that AM broadcasters would significantly benefit from IBOC technology and that IBOC "offers a chance to revitalize AM broadcasting." The NRSC made no findings about AM nighttime IBOC because of limited test results on nighttime operations. Nevertheless, the NRSC urged the Commission to immediately move forward with an endorsement of AM IBOC because of all the benefits identified with the iBiquity AM IBOC system.

The NRSC AM test program provided a comprehensive evaluation of daytime IBOC operations. The laboratory and field tests were structured to examine AM IBOC performance in typical AM situations and to determine AM IBOC compatibility with typical analog AM stations. The tests examined the impact of adjacent channel and co-channel interference on existing analog service and compared that with the performance of AM IBOC under identical conditions. Similar tests were conducted using channel impairments rather than interference. For compatibility tests, the IBOC system was examined for its impact on co-channel and

adjacent channel analog operations. The existing record developed from these tests represents a comprehensive examination of AM IBOC during daytime operation.

Based on the iBiquity Test Report and the NRSC Evaluation, the Commission should expeditiously endorse AM IBOC as the best means to implement DAB in the United States. The NRSC correctly recognized AM IBOC's ability to transform AM broadcasting. For each of the relevant evaluation criterion the Commission has developed, the NRSC found AM IBOC to be an improvement over analog AM service. With this record, the Commission should now move quickly to implement the NRSC's recommendation and endorse AM IBOC.

The NRSC's recommendation that the Commission proceed with a daytime only service while additional nighttime testing is conducted reflects the NRSC's enthusiasm about AM IBOC and the NRSC's belief that the benefits to the public of IBOC should not be delayed. Daytime authorization allows the Commission to expedite the introduction of digital service to the public with a low risk of interference to existing analog listeners. At the same time, this approach provides iBiquity and the broadcast industry with additional time to analyze the potential impact of AM IBOC on nighttime analog service and to develop an industry consensus on the best approach for nighttime. As a first step, the Commission should now proceed quickly with an endorsement of AM IBOC.

Finally, in order to promote the commercialization of this innovative new technology, the Commission should allow AM broadcasters to commence digital operations immediately while the Commission completes implementation of final IBOC rules.

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Comments of iBiquity Digital Corporation

iBiquity Digital Corporation (“iBiquity”) hereby submits its comments concerning AM In-Band On-Channel (“IBOC”) technology. In a recent Public Notice the Commission sought comment on iBiquity’s AM IBOC technology and proposals for implementation of IBOC later this year.¹ The Commission’s Public Notice was issued in response to a report from the National Radio Systems Committee (“NRSC”)² endorsing iBiquity’s AM IBOC Digital Audio Broadcasting (“DAB”) system as well as iBiquity’s report on its comprehensive laboratory and field tests conducted in 2001.³ The iBiquity Test Report and the NRSC Evaluation confirm for AM the same conclusions reached about FM IBOC: iBiquity’s IBOC DAB technology offers a significant improvement over analog AM and can be introduced in a manner that will not cause harmful interference to existing analog AM station operations. As is discussed in greater detail herein, iBiquity encourages the Commission to promptly endorse IBOC and the iBiquity system

¹ Public Notice, DA 02-899, MM Docket No. 99-325 (April 19, 2002).

² *Evaluation of the iBiquity Digital Corporation (iBiquity) IBOC System, Part 2-AM IBOC*, April 6, 2002 (hereinafter referred to as “NRSC Evaluation”).

³ iBiquity submitted a report on its AM testing to the Commission on April 15, 2002. Those test results are referred to herein as the “iBiquity Test Report”.

as the best means for introducing DAB in the United States and to facilitate the commercial introduction of IBOC technology later this year.

I. Background

AM radio was developed in the early 1920's and was the principal mass communication service in the United States for almost forty years. Since its inception, the number of operating AM stations in the United States has mushroomed from a handful in 1925 to approximately 5,000 today. The amount of advertising revenue and AM radio listeners grew concomitantly. With this success came many challenges. Competitively, AM was challenged first by television in the late 1940's and later by FM stereo in the early 1960's. As listeners at home migrated to television, AM radio became more focused on mobile service. Later, when FM stereo was introduced and proliferated, the technical disparity between AM and FM became apparent to listeners. FM stereo provided a clear and crisp sound with less interference than AM.⁴ At the same time that TV and FM were creating competitive challenges, the AM service also confronted a decline in technical quality.⁵

The combination of new competition from FM stereo and decreased AM technical quality promoted the relegation of AM to a primarily talk-only service. While some AM stations continued to flourish, the economic viability of others deteriorated. In response to this situation,

⁴ AM operates in medium wave spectrum while FM operates in VHF spectrum. AM is subject to interference from groundwave during the day and both groundwave and skywave during the night. In contrast to the VHF band, propagation characteristics of the AM band vary based on time and season. During daytime hours, signal propagation of an AM station is predominately by groundwave signals. These travel along the surface of the earth and are affected by the characteristics of soil conductivity along the propagation path. During nighttime hours, however, the reach of skywave signals from an AM station becomes significantly greater than the reach of its groundwave signals. Skywave signals are reflected from the ionosphere and can be propagated many hundreds of miles from the transmitter site. Consequently, co-channel stations may be located reasonably close to one another without interference during day light hours.

⁵ As the Commission has noted, "the number of new stations causing more than 1% of 'objectionable interference' rose from 2% in 1952 to 21% in 1962. The percentage receiving more than 1% rose from 18% to 36% in the same period." See *AM Station Assignment Standards*, 45 FCC 1515, 1522 (1964).

the Commission during the last thirty years has repeatedly taken steps to improve the viability of AM radio. These steps included: (i) establishment of “go-no-go” rules that prohibited the overlap of certain signal strength contours to prevent co-channel, first, second and third adjacent channel interference,⁶ (ii) rules to control expansion of AM service by limiting applications based on service to unserved areas and interference,⁷ (iii) proposing and rejecting rules to establish a 9kHz spacing requirement,⁸ (iv) introduction of AM stereo,⁹ (v) adoption of new AM groundwave and skywave propagation curves as a means to more accurately reflect signal coverage,¹⁰ and (vi) creation of the AM expansion band and migration of stations to this band as a means to decrease congestion in the existing bands.¹¹ As all the above proceedings demonstrate, the Commission has made a valiant effort over the last thirty years to improve AM. Nevertheless, AM still has many technical issues and remains competitive primarily when restricted to news/talk formats.

iBiquity, through its predecessor companies, has long recognized the need to upgrade AM radio. When IBOC technology was first proposed, a commitment was made to develop both AM and FM IBOC systems. The special issues associated with AM presented many challenges in developing an AM IBOC system. Nevertheless, iBiquity committed significant resources in response to these challenges and now believes that it has developed an AM IBOC system that

⁶ See *Report and Order* in Docket No. 15084, 45 FCC 1515 (1964).

⁷ See *Report and Order* in Docket No. 18651, 39 FCC 2d 645 (1973).

⁸ *9 kHz Channel Spacing for AM Broadcasting*, BC Docket No. 79-164, 88 FCC 2d 290 (1981).

⁹ *AM Stereophonic Broadcasting*, 51 RR 201 (1982).

¹⁰ *Improved Methods For Calculating Groundwave Field Strength In The AM Broadcast Band*, MM Docket No. 88-510, 5 FCC Rcd 4489 (1990).

¹¹ *Review of the Technical Assignment Criteria For the AM Broadcast Service*, MM Docket No. 87-267, *Report and Order*, 6 FCC Rcd 6273 (1991), and *Memorandum Opinion and Order*, 8 FCC Rcd 3250 (1993).

will eliminate many of the problems that exist for AM analog, improve the quality of the AM service and enable AM radio to more effectively compete in the marketplace.

II. The Broadcast Industry Supports Authorization of AM IBOC

During the last three years, iBiquity has worked very closely with the NRSC to develop and conduct tests of the AM IBOC system. Initially, the NRSC developed test procedures that would insure that reliable data could be collected that would provide the broadcast and consumer electronics industries, the FCC and the public accurate information on the performance of iBiquity's AM IBOC system. These procedures included both performance and compatibility tests with both objective and subjective measurements. Subsequent to the establishment of these procedures actual data was collected.¹² The final phase of the NRSC's work was drafting a report on the AM IBOC system performance which was submitted to the Commission on April 16, 2002.¹³

In its Report, the NRSC strongly recommends that the FCC move forward with the authorization of AM daytime IBOC. The NRSC based its endorsement on its conclusion that AM broadcasters would significantly benefit from IBOC technology and that IBOC "offers a chance to revitalize AM broadcasting."¹⁴ The NRSC made no findings about AM nighttime IBOC because of limited test results on nighttime operations.¹⁵ Nevertheless, the NRSC urged

¹² The actual tests were conducted using three independent laboratories. The Advanced Television Technology Center conducted all laboratory objective performance tests. Laboratory objective compatibility tests were performed at Xetron Corporation. Dynastat, Inc. conducted a subjective evaluation of laboratory and field sound samples that supplemented the objective test program. In addition, three commercial and one experimental AM broadcast stations were used to assess AM IBOC performance and compatibility under real world conditions.

¹³ See NRSC, *DAB Subcommittee, Evaluation of the iBiquity Digital Corporation IBOC Systems*, April 16, 2002.

¹⁴ NRSC Evaluation at 9.

¹⁵ Nighttime testing is complex because of the multiple signal paths and locations that need to be tested and observed as a result of skywave propagation. In the next several months, iBiquity will be conducting both

the Commission to immediately move forward with an endorsement of AM IBOC because of all the benefits identified with the iBiquity AM IBOC system.

As described above, repeated efforts to improve AM broadcasting have resulted in disappointments and new burdens on the AM band. Although the NRSC concluded the introduction of IBOC would involve certain tradeoffs and potentially more interference in a limited number of areas, the benefits of IBOC and the tremendous improvements that will be available from the all-digital AM IBOC mode provide sufficient incentive for the Commission to expedite its endorsement of AM IBOC. iBiquity encourages the FCC to adopt the NRSC recommendations and endorse AM IBOC as the best means to introduce terrestrial digital audio broadcasting in the United States. At the same time, it should allow AM stations to immediately begin to provide daytime digital service.

iBiquity plans to conduct additional AM IBOC tests and analyses this summer so it can accurately define how AM IBOC will work at nighttime. It believes that the information derived from these tests will enable the NRSC and the FCC to develop final AM IBOC rules for nighttime operations at the same time final rules are adopted for daytime operations. This effort, however, does not preclude in any way the authorization of initial daytime AM IBOC broadcasts this fall.

III. AM IBOC Satisfies the Commission's Evaluation Criteria for DAB

The NRSC AM test program provided a comprehensive evaluation of daytime IBOC operations. The laboratory and field tests were structured to examine AM IBOC performance in typical AM situations and to determine AM IBOC compatibility with typical analog AM

field observations and statistical analyses of the compatibility of nighttime AM IBOC with existing analog operations. These efforts will examine the impact of IBOC on both existing groundwave and skywave signals. In addition, iBiquity will examine existing analog interference and determine what changes, if any, would result from the introduction of IBOC.

stations. The tests examined the impact of adjacent channel and co-channel interference on existing analog service and compared that with the performance of AM IBOC under identical conditions. Similar tests were conducted using channel impairments rather than interference. For compatibility tests, the IBOC system was examined for its impact on co-channel and adjacent channel analog operations. The existing record developed from these tests represents a comprehensive examination of AM IBOC during daytime operation.

Application of the Commission's DAB evaluation criteria to the results of AM testing leads to the conclusion that AM IBOC provides an upgrade from existing analog service. iBiquity's earlier comments in this proceeding address several of the criteria that have equal applicability to AM and FM IBOC.¹⁶ iBiquity has outlined below the various criteria that have specific applicability to AM IBOC and the system's ability to satisfy those criteria.

A. Enhanced Audio Fidelity

The iBiquity Test Report included a number of tests that demonstrated AM IBOC offers greatly enhanced audio quality when compared with analog AM. In particular, the tests compared AM IBOC against both unimpaired FM analog and AM analog under a variety of interference and impairment conditions. The iBiquity Test Report confirmed AM IBOC provides enhanced audio quality that significantly improves the listening experience. When comparing AM IBOC and analog FM, listeners rated AM IBOC statistically the same as analog FM with "Rock", "Classical" and "Voiceover" samples. With "Speech", listeners rated AM IBOC close to analog FM or "FM-like".¹⁷ When listeners were asked to compare AM IBOC with analog AM, evaluators consistently preferred AM IBOC to analog AM. The AM IBOC

¹⁶ See Comments of iBiquity Digital Corporation, MM Docket No. 99-325, February 19, 2002.

¹⁷ iBiquity Test Report at 6.

performance subjective evaluation program involved 60 listeners evaluating over 300 sound samples. The performance tests examined the digital and analog operations in the presence of co-channel, first adjacent channel, and second adjacent channel interference, impulse noise and a variety of other channel impairments typically found in the AM band. For each of the four test genres (“Rock”, “Classical”, “Speech” and “Voiceover”), digital was judged to be far superior to analog.¹⁸ When analyzing these results, the NRSC concluded, “[T]he iBiquity AM IBOC system will allow AM broadcasters to provide listeners with two-channel stereo audio rivaling existing analog FM stereo in quality.”¹⁹ Based on these results, the Commission should make a finding that AM IBOC will provide improved audio fidelity.

B. Robustness

Both the iBiquity Test Results and the NRSC Evaluation confirm AM IBOC offers significant improvements in durability when compared to analog in all interference and most impaired conditions. The IBOC signal is receivable under impairment and interference conditions even with its relatively low power compared to analog. The NRSC test program called for an extensive analysis of both analog and digital performance under a wide range of conditions typically found in the AM band, included co-channel and adjacent channel interference, impulse noise and other channel impairments. All of the durability tests were conducted by adding the interference or impairment to both the digital and analog signals. Audio samples from the digital system just prior to the point of transition from enhanced mode to core mode and from core mode to analog were compared against the analog signal at that same level. The tests were structured in this manner to capture the enhanced digital and core digital before

¹⁸ *Id.* at 7.

¹⁹ NRSC Evaluation at 9.

they became impaired and to compare each with the analog available at that same level of interference or impairment.²⁰ The NRSC Evaluation contained a detailed analysis of the comparative performance of digital and analog in the numerous impairment and interference scenarios tested. Even with the variety of tests conducted, the NRSC conclusion was very concise: the digital system, “compared to analog AM, is substantially more robust under impulse noise and co- and adjacent channel interference conditions.”²¹

The NRSC tests did not address an additional benefit of the digital system. Specifically, the time diversity between the analog and digital signals ensures that the system does not experience the complete loss of signal when driving under bridges and power lines that is associated with analog AM. The test program was not designed to examine this system feature, but the blend and time diversity features ensure that the signal blends from digital to analog when there is loss of the digital signal. Although the blend may result in reception of lower quality analog rather than the digital signal due to a signal fade from an overhead obstruction, the lower quality analog signal is far superior to the complete loss of signal typically associated with today’s analog AM.²²

The NRSC Evaluation placed significant emphasis on the robustness of the AM IBOC system. The NRSC Evaluation found, “AM IBOC offers improved immunity from reception problems due to overhead power lines, grounded conductive structures (such as highway overpasses) and other forms of electromagnetic interference that plague existing services.”²³ iBiquity encourages the Commission to adopt these findings of the NRSC.

²⁰ iBiquity Test Report at 12-13.

²¹ NRSC Evaluation at 45.

²² iBiquity Test Report at 18.

²³ NRSC Evaluation at 9.

C. Compatibility

The NRSC Evaluation concluded AM IBOC can be implemented in the daytime without harmful interference to existing analog AM service. The NRSC examined the impact of the AM IBOC signal on the host analog and first, second and third adjacent channel analog signals. It concluded that IBOC would have little or no noticeable impact on host and third adjacent channel reception. In the case of first and second adjacent channel analog signals, the NRSC concluded the daytime benefits of AM IBOC greatly outweighed any potential impact on analog listeners. The NRSC reached this conclusion based on the fact that AM IBOC has the potential to “dramatically improve the AM listening experience” and that any area of potential impact to analog listening is likely to be outside the protected interference-free contour.²⁴ Thus the NRSC was able to recommend endorsement of AM IBOC for daytime service.

D. Flexibility/Auxiliary Capacity

The AM IBOC system offers broadcasters flexibility to meet the needs of their listeners. The AM system is comprised of two sets of digital carriers. The primary carriers contain 20 kbps “core” digital carriers providing monophonic sound. The secondary carriers contain 16 kbps “enhanced” carriers that add stereo sound. The system has been designed, however, to allow broadcasters that do not need stereo sound (such as stations using a News/Talk format) to devote the 16 kbps enhanced carriers to datacasting services without impacting the quality or coverage of the 20 kbps core audio service.²⁵ This flexibility will allow broadcasters to maximize the benefits of AM IBOC. Broadcasters that want to offer higher quality sound will be able to provide stereo programming. Other broadcasters that prefer to rely on monophonic

²⁴ *Id.*

²⁵ iBiquity Test Report at 18.

formats will have the opportunity to use the remaining system capacity to offer new services for their listeners. At all times, however, the broadcaster retains full discretion to shape the services to the needs of the listeners.

E. Coverage

iBiquity's field test program conducted for the NRSC used four stations to assess the coverage of the digital system. The tests demonstrated that the IBOC system provided an extensive digital service area. The AM IBOC system operates at approximately 5% of the power of analog AM. Nonetheless, the IBOC system was able to provide consistent daytime digital coverage to the 2 mV/m contour of the test stations. In some areas, coverage extended beyond the 1 mV/m contour.²⁶ The IBOC systems' blend-to-analog feature ensures that IBOC coverage will never be less than existing analog coverage. At the edge of digital coverage, the IBOC system smoothly transitions to analog to ensure that listeners will continue to receive a signal until the end of analog coverage.²⁷ The NRSC concluded that this level of coverage was comparable to analog AM coverage.²⁸ The NRSC's analysis went further, however, noting that, "Due to AM IBOC's improved resistance to various types of interference . . . AM IBOC service may be available in areas where analog service is currently of unacceptable quality due to such interference."²⁹

²⁶ *Id.* at 9. Subsequent tests have indicated consistent digital coverage to the 1 mV/m contour with some coverage extending to the 0.5 mV/m contour.

²⁷ *Id.* at 11.

²⁸ NRSC Evaluation at 45.

²⁹ *Id.*

Although the iBiquity Test Report and the NRSC Evaluation focused on hybrid mode operations, iBiquity also conducted tests of the AM all-digital mode.³⁰ These all-digital tests were designed to confirm the all-digital system is viable and will extend coverage beyond that of hybrid mode operations. By extending the digital coverage, the all-digital system ensures that IBOC replicates the full extent of analog coverage. iBiquity's all-digital tests were conducted using WTOP in Washington, D.C. at night and iBiquity's experimental test station in Cincinnati, Ohio during the day. The all-digital tests confirmed the significant extension in digital coverage offered by the all-digital mode. At night on WTOP, all-digital coverage extended beyond the 2 mV/m contour, which is WTOP's nighttime interference free contour. This represented a significant extension from the hybrid digital coverage on WTOP. In Cincinnati, daytime all-digital coverage extended beyond the 0.1 mV/m contour. Again, this improved on the 1 mV/m contour coverage obtained with the hybrid mode of operation.

IV. The Commission Should Endorse AM IBOC and Authorize Daytime Service

Based on the iBiquity Test Report and the NRSC Evaluation, the Commission should expeditiously endorse AM IBOC as the best means to implement DAB in the United States. The NRSC correctly recognized AM IBOC's ability to transform AM broadcasting. For each of the relevant evaluation criteria the Commission has developed, the NRSC found AM IBOC to be an improvement over analog AM service. The Commission should move quickly to implement the NRSC's recommendation and endorse AM IBOC.

The NRSC's recommendation that the Commission proceed with a daytime only service while additional nighttime testing is conducted reflects the NRSC's enthusiasm about AM IBOC and the NRSC's belief that the benefits to the public of IBOC should not be delayed. Daytime

³⁰ AM All-Digital IBOC Field Test Report dated April 12, 2002.

authorization allows the Commission to expedite the introduction of digital service to the public with a low risk of interference to existing analog listeners. At the same time, this approach provides iBiquity and the broadcast industry with additional time to analyze the potential impact of AM IBOC on nighttime analog service and to develop an industry consensus on the best approach for nighttime. As a first step, the Commission should now proceed quickly with an endorsement of AM IBOC.

V. The Commission Should Allow Stations to Commence Daytime AM IBOC Broadcasts Pending Development of Final IBOC Rules

In order to promote the commercialization of this innovative new technology, the Commission should allow AM broadcasters to commence digital operations immediately while the Commission completes implementation of final IBOC rules. As iBiquity has detailed in its previous comments in this proceeding, the broadcast industry is poised for full commercial introduction of IBOC.³¹ iBiquity's strategic partners and owners in the broadcast and equipment manufacturing businesses are preparing for launch of commercial service to the public in early 2003. Manufacturers of commercial transmission equipment have already begun sales of IBOC equipment. The semiconductor industry is scheduled to produce IBOC chips this fall to support manufacture of commercial IBOC radios for sale next year. Numerous receiver manufacturers have announced publicly plans to launch commercial IBOC receivers at the Consumer Electronics Show in January 2003. All this activity, however, is dependent on the Commission endorsement of IBOC and authorization of digital broadcasts commencing this fall. iBiquity continues to plan to introduce digital broadcasts in six rollout cities before the end of the year. Commission endorsement of AM and authorization of digital service, even on an interim basis

³¹ Reply Comments of iBiquity Digital Corporation, March 21, 2002 at 4-13.

pending development of final IBOC rules, will foster iBiquity's commercialization schedule and the prompt introduction of the benefits of IBOC technology.

VI. Conclusion

Based on the foregoing, iBiquity Digital Corporation respectfully requests that the Commission accept these comments and promptly adopt an endorsement of iBiquity's IBOC system.

Respectfully submitted,

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